THE EFFECT OF ICT INTEGRATED CUM MIND MAP METHOD VERSUS TRADITIONAL METHOD IN SCIENCE AT THE MIDDLE SCHOOL LEVEL

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ABSTRACT

The study aims to explore and compare the effectiveness of ICT integrated cum mind map method over traditional method on the performance of students in science at the middle school level. Previous studies have proved that ICT and mind map contribute significantly to learners' improvement and achievement. The study was performed on a group of 50 students of class VI who were considered both as the control group and experimental (target) group. The selected lesson was first taught by traditional method and an achievement test was conducted. After a gap of one month again the same lesson was taught by ICT integrated cum mind map method and this was followed by another achievement test. The purpose of taking two achievement test was to compare the scores of the students and relate with the objectives of the study. The results obtained proved that there was a significant difference in the achievement level of learners when ICT integrated cum mind map method was used. The study resolves the problem that the difficult and abstract topics in science could be easily comprehended by students with incorporation of power point presentations, images, short videos and mind map as teaching learning materials.

KEYWORDS

ICT, mind map, traditional, power point presentation

1. INTRODUCTION

Today in the 21st century, learners are referred as digital generation, therefore teaching learning process cannot be kept away from Information and Communication Technology. This is the century of instilling emerging technologies where educators use digital resources or multimedia to improve their teaching methods and on the other hand learners will also be benefitted in constructing knowledge. Earlier teachers used the lecture method in the teaching and learning process, despite the fact that students' attention tends to wane over time. The lecture technique only attracts students with listening skills [1], which makes the learning environment unpleasant. Science teaching deals with abstract phenomenon and processes that very often can't be seen or felt. Many studies indicated difficulties in learning and teaching science among students as well as teachers [2]. Because students frequently encounter obstacles in learning, it is critical for teachers to use a variety of methods to keep students motivated during this learning interaction process [1]. In modern education it is of prime importance that the educators should incorporate creativity in the teaching methodology by using The Mind Map method along with ICT.

The Mind Map is a simple conceptual graph of organised content which helps in easy understanding of subject matter. The mind map method is one of the techniques proposed by Tony Buzan in 1970, based on his research on how the brain works, by writing or noting the main topic in the middle and writing sub topics and the details are placed around the main topic. This mind map recording technique is designed based on how the brain works in processing information [3].Modern education has been undergoing an unprecedented expansion in the recent past and it is proven to be extending lots of educational provisions, right from primary to tertiary levels.

In order to conduct teaching learning process smoothly and in interesting manner teachers and learners choose ICT based education. The advantage of incorporating PowerPoint presentations, Audio Visual aids and Mind Map is the images and keywords used here are to link facts and piece of information by the students in order to generate complete knowledge. Studies conducted earlier have shown that use of multimedia has positive effect on students and this also overcome the drawbacks of traditional method of learning. Immersion into content knowledge, constructing knowledge and development of complex thinking skills have been increased with the effectiveness of ICT [4]. According to [5], there will be many benefits of using ICT for teaching and learning process. The modern approaches of teaching methodology will overcome the difficulty faced by students in understanding a concept via lecture method only. Educators using both ICT and mind map will have an advantage of diversifying their teaching methodology and will be able to meet the requirements of broader range of learners. The combination of two will facilitate acquisition of long-lasting knowledge by the learners.

2. LITERATURE REVIEW

Enhancing performance of students in academics is a critical issue which must be given prime importance; mainly at this time when there is so much competition and also everything is becoming technology based. The poor performance of students has been attributed to lack of active participation of students in the teaching and learning process. In order to achieve this, it is thus necessary that teachers apply the appropriate teaching methods and strategies that best suit the students in terms of their understanding ability so that the stated specific objectives can be achieved. The traditional approach to teaching and learning usually involves the directed flow of information from teacher as sage to student as receiver. This can be also defined as a pre-technology education in which the teacher is the sender or the source of information, the educational material is the information or message, and the student is the receiver of the information. The world is changing so rapidly that it has a remarkable impact on academics. E-learning has altered the area of academics and education.

According to [6]the world that awaits us is a world of huge technical change and ICT enables self-paced learning through various tools such as assignments, computer etc. as a result of this the teaching learning enterprise has become more productive and meaningful. This promotes active learning, sharing of ideas, discussion and also provides immediate feedback. The present high tech and competitive society will sustain only through the knowledge of ICT and it represents one of the current applications of technology towards teaching- learning processes. Appropriate use of ICT can transform the whole teaching-learning processes leading to paradigm shift in both content and teaching methodology. The new environment of interactive learner-centred approach of ICT has completely metamorphosised the process of education i.e. delivery and dissemination. The above-mentioned research paper attempts to discuss about the role of ICT in the classroom situation. The use of PowerPoint, animation, graphics can be utilized to enhance the learning of content. Computer-aided learning is not a replacement technology but a complementary tool.

As stated in [7] that MS Powerpoint is the most commonly used program in terms of lesson delivery inside the classroom. With the use of the software, students were able to better understand the lessons compared to the traditional ways of delivering the lessons. The experimental group has shown an improvement in their academic performance in terms of all three subjects. Based on the data gathered and findings presented, the researchers concluded that there was a significant difference between the Pre-test and Post-test of the experimental group in terms to the three subjects which are Math, English and Science. The findings of the studies make it evident that PowerPoint may be an excellent pedagogical technology tool for classroom instruction, facilitating both teaching and learning. Teachers and students alike can benefit from it. On the other hand, we must ensure that their PPT presentations are tailored to match the needs of their students in order to help them develop all of the necessary skills and comprehension.

Evidences from [8] discussed about some factors that are responsible for the poor performance of students in the compartmentalized science like Chemistry, Physics, Biology and Mathematics. These factors may include students' negative attitude towards these subjects which is invariably affecting their interest and also various shortcomings of the teachers as well on the other end. Many studies have been conducted to improve students' performance in sciences at the senior level, only few studies have known or considered mind-mapping as a self-regulated learning strategy for students at the young stage. The mind map when used as part of instructional approach is potent at increasing students' achievement score, knowledge and retention. The result of the finding showed that interaction of gender and method does not produce any significant effect on performance of students in Basic Science and Technology. He said further that gender does not affect students' learning of science and their performance. He reiterated that less learning difficulties will be encountered by students irrespective of their sexes when the right method and teaching strategies are used. Based on the articles reviewed, it is possible to conclude that the mind map method can improve students' achievement in academics. There is no perfect method, but culmination of all methods improves students' ability to receive school lessons. The mind map method can increase student activity and participation in learning in elementary subject material. A mind map is a fun strategy that makes learning more interesting and enjoyable. The results of the observations show the success rate of the mind map method in teaching science lessons in school.

3. OBJECTIVES OF THE STUDY

The following objectives are formulated for the study.

1. To study the effect of ICT integrated cum Mind Map method on performance of students in Science at Middle level.
2. To compare the effect of Traditional methodology and ICT integrated cum Mind Map methodology on performance of students in Science at Middle level.

4. HYPOTHESES OF THE STUDY

The following hypotheses are formulated to empirically validate the above objectives.

H_o1. There will be no significant difference in the performance of students in Science between the experimental group and the control group in relation to ICT integrated cum Mind Map method and traditional method.
H_o2. There will be no significant difference in the performance of students in Science between the experimental group and the control group in relation to ICT integrated cum Mind Map method and traditional method on the basis of gender.

H_O3. There will be no significant difference in the mean scores of students in Science between the experimental group and the control group in relation to ICT integrated cum Mind Map method and traditional method on the basis of their performance in achievement test.

5. DELIMITATIONS

1. The study is delimited to CBSE students of standard VI enrolled in an English Medium School.
2. The study is delimited to urban areas where schools are equipped with smart board (ICT) infrastructure facility.
3. This study is also delimited to only one unit of science subject at the middle school level.
4. This study is conducted in a limited time duration (six periods: three each for traditional method of teaching and ICT integrated cum mind map method of teaching).

6. METHODOLOGY

The researcher has employed Purposive Sampling method to select participants as sample from the target population and used Experimental Research Design method to test the formulated hypotheses. It is a Quasi experimental research (pre-test – post-test – control group design). The target population of the study will be the students of Class VI of a CBSE school located in South Kolkata, West Bengal. For the present study, experimental study was conducted on comparison of traditional methodology and ICT integrated cum Mind Map methodology. The school will choose students through purposive sampling. The samples are **50 Class VI students** of a CBSE school located in South Kolkata, West Bengal. The tools and techniques used for experimentation and data collection are- i) Treatment Module (Teaching the lesson first with Traditional Methodology followed by ICT integrated cum mind map methodology, after a gap of one month), ii) Diagnostic Test (Pre-test), iii) Achievement Test (Post-test).

Table 1. Procedure of experimentation and data collection

GROUP	PRE-TEST	TREATMENT	POST-TEST
Control	O_1	X_1	O_2
Experiment	-	X_2	O_3

Pre-test:- O_1
Post-test:- O_2 and O_3

X_1 = Traditional methodology
X_2 = ICT integrated cum Mind Map method

VARIABLES:

a) Independent Variables - Traditional methodology, ICT integrated cum Mind Map method
b) Dependent Variables – Academic achievement in Science.

7. ANALYSIS AND INTERPRETATION

H_O1-There will be no significant difference in the performance of students in Science between the experimental group and the control group in relation to ICT integrated cum Mind Map method and traditional method.

7.1. Percentage of Mean on the Basis of Method of Teaching

Sample (Number of Students) = 50

Table 2. Percentage of mean on the basis of method of teaching

Tests	O_1	O_2	O_3
Mean	6.96	15.92	18.02
Percentage of mean	34.8%	79.6%	90.1%

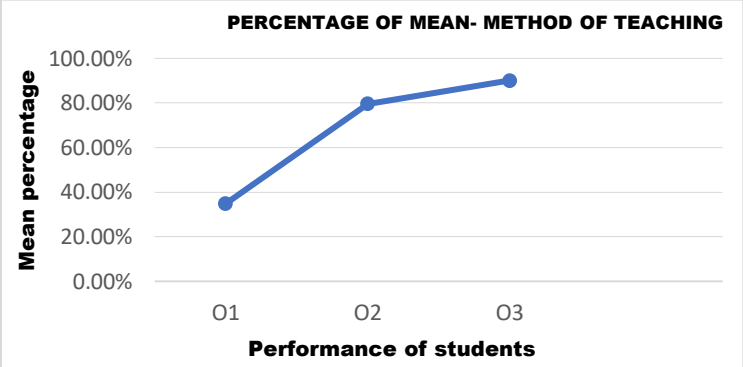

Figure 1. Percentage of mean on the basis of method of teaching

Figure 1depicts that students could not perform well in diagnostic test (O_1 – 34.8%) as the lesson was not taught and few questions were tricky. On the basis of whatever previous knowledge students had, they could score accordingly. Then post Treatment X_1, there is an improvement seen in the performance level of students due to the rise in the slope of the line graph. However, after a gap of one month Treatment X_2implemented and the performance level of students was more satisfactory. Thus, we can say that there is a gradual rise in mean score obtained by students in achievement tests (O_2 – 79.6% and O_3 – 90.1%) with respect to the type of teaching method used by the teacher. With this improvement in performance level, we can conclude that ICT integrated cum mind map methodology is an accepted and preferred method by teachers.

7.2. Mean Difference on the Basis of Method of Teaching

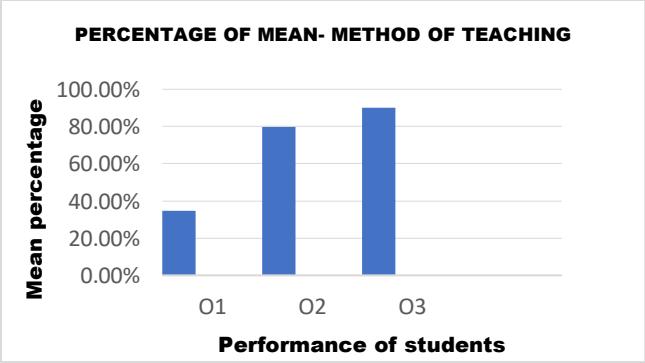

Figure 2. Mean difference on the basis of method of teaching

Figure 2 interprets that the difference in height of column bar where it is short for diagnostic test (O_1 – 34.8%), followed by rise in height of column bar depending upon improvement in

performance level of students in both the achievement tests (O_2 – 79.6% and O_3 – 90.1%). In conclusion, we can say that ICT integrated cum mind map method of teaching is found to be more effective than the traditional method of teaching as we can notice the increasing trend.

A 't-test' is be done to check if there is a significant difference in the mean scores of students when they are taught by ICT integrated cum mind map method and Traditional method:

Table 3. Testing of Hypothesis 1

Descriptive statistics					**t test for equality of means**			**Remarks**
Independent variable	Dependent variable	N	Mean	SD	df	t calculated	t table value	Significant at 0.05 level of significance
Traditional teaching method	Post- test (O2) achievement test scores	50	15.92	2.65	98	3.96	1.98	Significant at 0.05 level of significance
ICT integrated cum mind map method	Post- test (O3) achievement test scores	50	18.02	2.65	98	3.96	1.98	Significant at 0.05 level of significance

* 0.05 level of significance

Both the groups of students were subjected to teaching by traditional method and ICT integrated cum mind map method within a gap of one month to compare their effectiveness. The table shows that the mean of post test score (O_2) of control group i.e. traditional method of teaching is 15.92 with 2.65 SD and the mean of post test (O_3) score of experimental group i.e. ICT integrated cum mind map method is 18.02 with 2.65 SD. Whether the difference of mean is significant or not, the t test is employed and after analysis it was found that the calculated t (98) = 3.96, table value = 1.98. Since the calculated 't' value is higher than the table value, therefore the value of 't' is significant and H_O1 is rejected at 0.05 level of significance. So, the hypothesis was not accepted.

H_O2- There will be no significant difference in the performance of students in Science between the experimental group and the control group in relation to ICT integrated cum Mind Map method and traditional method on the basis of gender.

7.3. Percentage of Mean on the Basis of Gender

Total number of boys in the class = 35
Total number of girls in the class =15

Table 4. Percentage of mean on the basis of gender

Gender	**O_1**	**O_2**	**O_3**
Girls (mean, %)	7.13, 35.65%	15.6, 78%	17.93, 89.65%
Boys (mean, %)	6.88, 34.4%	16.05, 80.25%	18.05, 90.25%

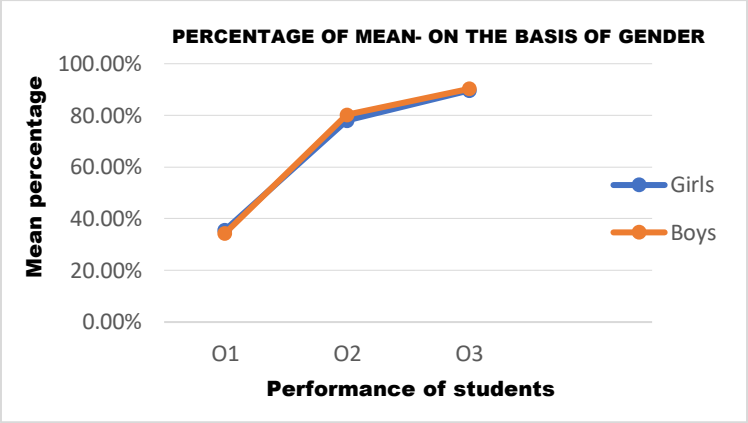

Figure 3. Percentage of mean on the basis of gender

Figure 3 depicts that both girls and boys could not perform well in diagnostic test (O_1 – girls:35.65%, boys:34.4%). Then after Treatment X_1, there is an improvement seen in the performance level of both girls and boys due to the rise in the slope of the line graph. However, after a gap of month Treatment X_2 was executed and the level of performance has enhanced further. Thus, we can say that there is a gradual rise in mean score obtained by girls and boys in achievement tests (O_2 – girls:78%, boys: 80.25% and O_3 – girls:89.65%, boys: 90.25%). Therefore, we can conclude that both the genders are equally benefitted with ICT integrated cum mind map method of teaching.

7.4. Mean Difference on the Basis of Gender

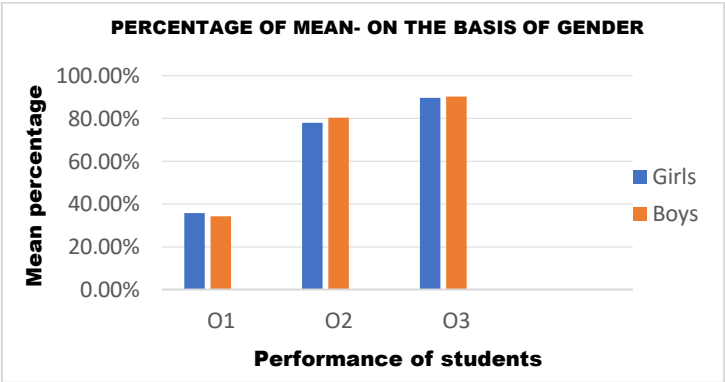

Figure 4. Mean difference on the basis of gender

Figure 4 interprets that the difference in height of column bars for both girls and boys in diagnostic test (O_1 – girls: 35.65%, boys: 34.4%), followed by gradual rise in height of column bar for both girls and boys depending upon improvement in performance level of students in subsequent achievement tests (O_2 – girls: 78%, boys: 80.25% and O_3 – girls: 89.65%, boys: 90.25%). We can conclude here that ICT integrated cum mind map method of teaching is found to be more effective than the traditional method of teaching as we can observe the increasing trend. Also, this method is not bias for a particular gender and has significant impact on both gender.

a) A 't-test' is done to check if there is a significant difference in the mean scores of girls and boys when they are taught by Traditional method:

Table 5a. Testing of Hypothesis H_O2 (Traditional teaching method)

Descriptive statistics					**t test for equality of means**			**Remarks**
Independent variable	Dependent variable	N	Mean	SD	Df	t calculated	t table value	Significant at 0.05 level of significance
Girls	Post- test (O2) achievement test scores	15	15.6	2.74	48	0.54	2.011	Not significant at 0.05 level of significance
Boys	Post- test (O2) achievement test scores	35	16.05	2.74	48	0.54	2.011	Not significant at 0.05 level of significance

* 0.05 level of significance

Both the genders were subjected to teaching by traditional method and ICT integrated cum mind map method within a gap of one month to compare their effectiveness. The table shows that the mean of post test score (O_2) of control group i.e. traditional method of teaching for girls is 15.6 with 2.74 SD and for boys is 16.05 with 2.74 SD. Whether the difference of mean is significant or not, the t test is employed and after analysis it was found that the calculated t (48) = 0.54, table value = 2.011. Since the calculated t value is lower than the table value, therefore the value of 't' is not significant and H_O2 is accepted at 0.05 level of significance. So, the hypothesis was accepted.

b) A 't-test' is done to check if there is a significant difference in the mean scores of girls and boys when they are taught by ICT integrated cum Mind Map method:

Table 5b. Testing of Hypothesis H_O2 (ICT integrated cum mind map teaching method)

Descriptive statistics					**t test for equality of means**			**Remarks**
Independent variable	Dependent variable	N	Mean	SD	Df	t calculated	t table value	Significant at 0.05 level of significance
Girls	Post- test (O3) achievement test scores	15	17.93	2.56	48	0.15	2.011	Not significant at 0.05 level of significance
Boys	Post- test (O3) achievement test scores	35	18.05	2.56	48	0.15	2.011	Not significant at 0.05 level of significance

*0.05 level of significance

Both the genders were subjected to teaching by traditional method and ICT integrated cum mind map method within a gap of one month to compare their effectiveness. The tableshows that the mean of post test score (O_3) of experimental group i.e. ICT integrated cum mind map method of

teaching for girls is 17.93 with 2.56 SD and for boys is 18.05 with 2.56 SD.Whether the difference of mean is significant or not, the t test is employed and after analysis it was found that the calculated t (48) = 0.15, table value = 2.011. Since the calculated t value is lower than the table value, therefore the value of 't' is not significant and H_O2 is accepted at 0.05 level of significance. So, the hypothesis was accepted.

H_O3- There will be no significant difference in the mean scores of students in Science between the experimental group and the control group in relation to ICT integrated cum Mind Map method and traditional method on the basis of their performance in achievement test.

7.5. Percentage of Mean on the Basis of Achievement Level

Total marks of Test = 20

Table 6. Percentage and marks

Category	Percentage out of 100	Marks out of 20
Low achievers	0-32%	0-6
Medium achievers	33-70%	7-14
High achievers	71-100%	15-20

Table 7. Percentage of mean on the basis of achievement level

Level of achievement	O1	O2	O3
High achievers (mean, %)	0, 0%	16.97, 84.85%	18.41, 92.05%
Medium achievers (mean, %)	7.49, 39.7%	13.44, 67.2%	8.5, 42.5%
Low achievers (mean, %)	4.66, 23.3%	6, 30%	0, 0%

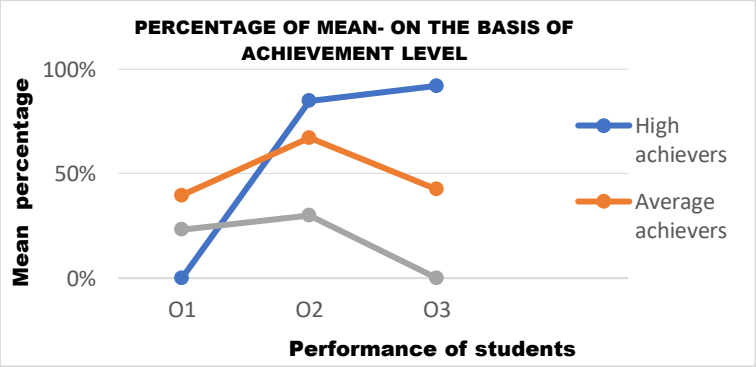

Figure 5. Percentage of mean on the basis of achievement level

Figure 5 depicts that there are no student (0%) in high achievers category, more students (39.7%) in medium achievers category and few students (23.3%) in low achievers category in diagnostic test (O_1). Then the sample was given Treatment X_1, then the students' performance level in each category rises (high achievers- 84.85%, medium achievers- 67.2%, low achievers- 30%) and this steeper slope is also seen in the graph. However, after a gap of one month the same sample was given Treatment X_2 and the students' performance level has enhanced further (high achievers- 90.05%, medium achievers- 42.5%, low achievers- 0%). Therefore, we can conclude that percentage of students in high achievers category has increased and on the contrary percentage of

students in low achievers category has decreased gradually. It means that ICT integrated cum mind map teaching method will any day be preferred by the teacher due to improved results.

7.6. Mean Difference on the Basis of Achievement Level

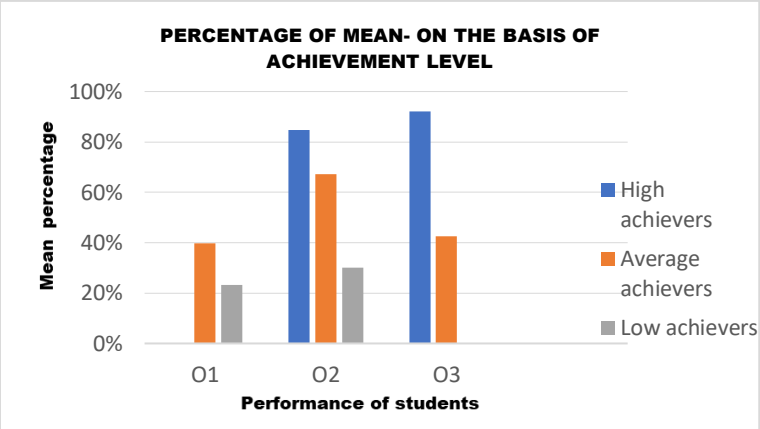

Figure 6. Mean difference on the basis of achievement level

Figure 6 interprets that in diagnostic test (O_1) there are no high achievers, comparatively some students are medium achievers and a few are low achievers observing the column graph. For achievement test (O_2) there is a significant rise in students' performance and many were high achievers, some students were medium achievers and very few low achievers. Therefore, after execution of Treatment X_1 there is drastic rise in number of students in high achievers category. This is followed by achievement test (O_3) where there is a marginal change in the graph but most of the students in the class are high achievers, comparatively some are medium achievers and none are low achievers. In conclusion, we can say that although traditional method imparts superficial knowledge and concept to the students but better and deeper understanding can be only achieved by ICT integrated cum mind map teaching method as even the slow learners attain a satisfactory level of performance.

N. B. In order to test the hypotheses (H_O1 and H_O2), previously t- test was done which is a parametric test but for testing the hypothesis H_O3 Chi- square test is performed which is a non- parametric test and the normality cannot be maintained due to time constrain.

Table 8. Table of Contingency

	Control Group (Traditional method of teaching)	**Experimental Group (ICT integrated cum mind map method of teaching)**	**Total**
No. of High achievers	39 (f_1)	48 (f_4)	87
No. of Medium achievers	9 (f_2)	2 (f_5)	11
No. of Low achievers	2 (f_3)	0 (f_6)	2
Total	50	50	Grand Total= 100

Table 9. Table of χ^2 (Chi- square) calculation

f_o	f_e	$f_o - f_e$	$(f_o - f_e)^2$	$(f_o - f_e)^2 / f_e$	$\chi^2 = \sum(f_o - f_e)^2 / f_e$
39	16.7	22.3	497.29	29.77	
9	16.7	-7.7	59.29	3.55	
2	16.7	-14.7	216.09	12.93	
48	16.7	31.3	979.69	58.66	
2	16.7	-14.7	216.09	12.93	
0	16.7	-16.7	278.89	16.7	**134.54**

***0.01 level of significance**

f_e (expected value) = 50/3 = 16.7

Degree of freedom (df)= 3-2= 1

Table value= 9.21

Calculated χ^2 value= 134.54

Hence χ^2 value 134.54 > 9.21

Both the groups of students were subjected to teaching by traditional method and ICT integrated cum mind map method within a gap of one month to compare their effectiveness. The table of contingency tabulates number of students in high acheivers, medium achievers and low achievers category to obtain the grand total. Whether the difference of mean of achievement level is significant or not, the Chi- test is employed and after analysis it was found that the calculated χ^2 value= 134.54 and table value = 9.21. Since the calculated χ^2 value is higher than the table value, therefore the χ^2 value is significant and H_O3 is rejected at 0.01 level of significance. So, the hypothesis was not accepted.

7.7. Percentage of Student on the Basis of Achievement Level

Table 10. Number of students in each category based on performance in tests

Category	**O_1**	**O_2**	**O_3**
High achievers	0	39	48
Medium achievers	35	9	2
Low achievers	15	2	0

Table 11: Percentage of students in each category on the basis of performance in tests

% of Students	**O1**	**O2**	**O3**
% of High achievers	0%	78%	96%
% of Medium achievers	70%	18%	4%
% of Low achievers	30%	4%	0%

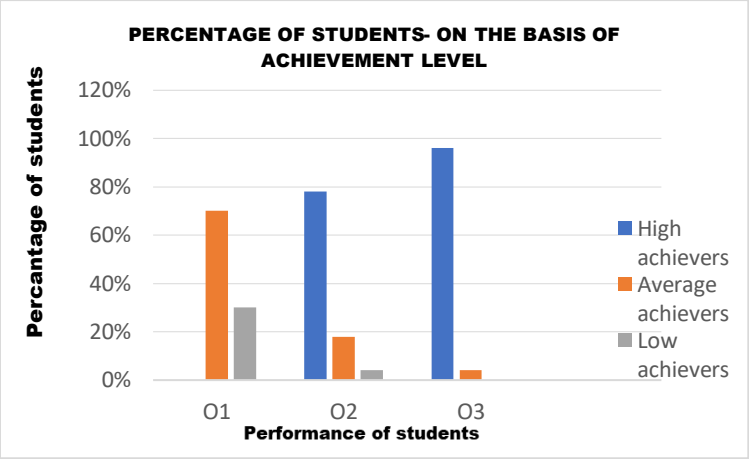

Figure 7. Percentage of student on the basis of achievement level

Figure 7 interprets that in diagnostic test (O_1) there are no high achievers at all, 70% of students were medium achievers and 30% were low achievers. For achievement test (O_2) there is a noticeable variation in the column graph as it includes 78% high achievers, 18% medium achievers and 4% low achievers. Therefore, after Treatment X_1 students got idea about the concept and could score well. This was followed by Treatment X_2 and another achievement test (O_3) was conducted after a gap of one month where we could see a marginal change in the column graph because 96% were high achievers, 4% were medium achievers and no low achievers at all. In conclusion, we can say that although traditional method but better and deeper understanding can be only achieved by ICT integrated cum mind map teaching method as even the slow learners attain a satisfactory level of performance.

8. MAJOR FINDINGS OF THE STUDY

- **Findings of Objective 1**- To study the effect of ICT integrated cum Mind Map method on performance of students in Science at Middle level.

  i) With use of digital resources like power point presentation, audio visual aid and Mind map students gain deeper understanding of the abstract and difficult concept easily.
  ii) Students of experimental group were able to comprehend the concept Joints when Treatment X_2 was executed and thus enhancing their academic performance more than the control group.

- **Findings of Objective 2** - To compare the effect of traditional methodology and ICT integrated cum Mind Map methodology on performance of students in Science at Middle level.

  i) With use traditional method sometimes, it becomes difficult to present a concept of the lesson to the students teaching is monotonous, teacher centric and no TLM (digital resources and mind map) used. So, traditional method does not seem fruitful in transaction of the lesson.
  ii) With use of ICT integrated cum Mind Map method the teacher is able to explain the concept of Joints (location, function) in a very easy with supporting TLM (digital resources and mind map) being used. It was also observed that students were more attentive and enjoyed the ICT integrated cum Mind Map teaching method. So, this method was found to be beneficial to the students as depicted in their performance.

9. DISCUSSION OF RESULTS

9.1. Results of Hypotheses Testing

Table12. Results of Hypotheses Testing

Sl. No.	Hypotheses of the study	t value /χ value	Level of significance	Accepted/ Rejected
1.	There will be no significant difference in the performance of students in Science between the experimental group and the control group in relation to ICT integrated cum Mind Map method and traditional method.	t value = 3.96	0.05	Rejected
2.	There will be no significant difference in the performance of students in Science between the experimental group and the control group in relation to ICT integrated cum Mind Map method and traditional method on the basis of gender.	(O_2): t value = 0.54; (O_3): t value = 0.15	0.05	Accepted
3.	There will be no significant difference in the mean scores of students in Science between the experimental group and the control group in relation to ICT integrated cum Mind Map method and traditional method on the basis of their performance in achievement test.	χ value= 134.54	0.01	Rejected

One of the findings of the study revealed that there is a significant difference in the mean percentage of achievement test (O_2 and O_3) scores among students taught science using lecture methodology and ICT integrated cum mind map methodology. Achievement test (O_3) revealed that ICT integrated cum mind map method of teaching is more effective than the traditional method. Furthermore, we can notice another major finding that there is a significant difference in the mean percentage of achievement test (O_2 and O_3) scores for both girls and boys specifically when taught science using lecture method and ICT integrated cum mind map method. We can observe that when the lesson was taught using traditional method of teaching both girls and boys could not meet all the learning objectives and there were gaps in understanding the difficult concepts whereas both the genders are equally benefitted with ICT integrated cum mind map method of teaching. This may have aided both male and female students' comprehension of science concepts in ICT integrated cum mind map method. Students when taught using ICT integrated cum mind map methodology were given the opportunity to discover knowledge for themselves by connecting points of mind map, seeing pictures and visuals. Third major finding of the study is that there is no significant difference between the mean percentage of achievement test (O_3) scores of girls and boys taught science using ICT cum mind-map method. In other words, we can say that this teaching methodology has equally enhanced the mean achievement scores of girls and boys. Based on the findings it may be concluded that this method is not bias for a particular gender and may have equally stimulated and captured the interest of both male and female students. Next major finding of the study is that some students have basic idea or knowledge from previous schema which help them further in learning a new concept. Thus, it is observed that only those students could score well in pre-test (O_1). Later traditional method was used to conduct the lesson and with rote learning and memorization many students have shown gradual improvement and satisfactory performance in post-test (O_2) but better understanding of any subject matter and long-term retention can be only achieved by ICT cum mind map integrated teaching method based on the findings of post-test (O_3) which depicts even the slow

learners attained a better level of performance. Although, as per the findings maximum students in the class have managed to achieve the learning objectives.

10. IMPLICATIONS AND CONCLUSIONS OF THE STUDY

The present study the effect of ICT integrated cum mind map method versus traditional method in science at the middle school level' showed that the main effect of treatment given to students is quite evident and is reflected in their performance. ICT integrated cum mind map method increased interest and boosts motivation level of students. The findings indicated a significant rise in achievement of students when ICT integrated cum mind map method was implemented by comparing two post-test (O_2 and O_3) scores of students in control (traditional method) and experimental (ICT integrated cum mind map method). When power point presentations including 2D and 3D images, short video clips and along with supporting mind map are used as TLM students understand the content in a much better way by associating ideas, develop deeper and long-term knowledge of the concept, thinks creatively and retain the subject matter in an effective manner which might not be otherwise possible by traditional chalk and blackboard method. The study also concluded that there is no connection between type of teaching method used and gender as it does not produce any significant result and both girls and boys are benefitted with ICT cum mind map teaching methodology. Therefore, none of the gender is specifically favoured. ICT integrated cum Mind map method is found to be equally effective for all category of learners- high achievers, medium achievers and low achievers. This is a self-learning method which helps the students in easy learning by actually understanding the concept on screen and then connect the points of learning in the mind map. In the present era, technology enhanced learning method is more preferred over traditional method of learning which is required for developing scientific skills and technological skills and this will raise the teaching standard and also economy of the nation.

11. SUGGESTIONS FOR FURTHER RESEARCH

In relevance with the delimitations of this study:

i) Since the number of samples in the study was limited to fifty, so further studies can be conducted including larger number of samples.
ii) Since the sample included only standard VI CBSE students, so further research can be conducted including students from other boards (state boards, ICSE) and other grades (VII, VIII, IX, X etc.) as well.
iii) The study was only based on data collected from achievement scores of students in one lesson of science, so more chapters can be included in further research to obtain more clear results in support of effectiveness of ICT integrated cum mind map teaching methodology. Also, same study can be conducted for other subjects like Mathematics, English etc.
iv) Since this study was conducted for students residing in urban areas, so further studies can be taken up for samples residing in rural areas too.

REFERENCES

[1] R. M. Sari, Sumarmi, I. K. Astina, D. H. Utomo, and Ridhwan, "Increasing Students Critical Thinking Skills and Learning Motivation Using Inquiry Mind Map," *International Journal of Emerging Technologies in Learning*, vol. 16, no. 3, pp. 4–19, 2021.

[2] M. Barak and Y. J. Dori, "Science education in primary schools: Is an animation worth a thousand pictures?, "*Journal of Science Education and Technology*, vol. 20, no. 5, pp. 608–620, 2011.

[3] R. A.Karim, "Technology-Assisted Mind Mapping Technique in Writing Classrooms: An Innovative Approach, "*International Journal of Academic Research in Business and Social Sciences*, vol. 8, no. 4, pp.1092–1103, 2018.

[4] R. B. Kozma, "National Policies That Connect ICT-Based Education Reform To Economic And Social Developmen, ". *Human Technology*, vol. 1, no. 2, pp. 117-156, 2005.

[5] S. Harris, "Innovative pedagogical practices using ICT in schools in England," *Journal of Computer Assisted Learning*, vol. 18, no. 4, pp. 449-458, 2002.

[6] A. Sharma, K. Gandhar, S. Sharma, Seema. "Role of ICT in the Process of Teaching and Learning," *Journal of Education and Practice*, vol. 2, no. 5, 2011.

[7] B. E. Joanna, N. Mecmack, "The Effects of Using MS Powerpoint as E-Learning Material to the Academic Performance of the Senior High School Students, "*International Journal of Psychosocial Rehabilitation*,vol.24, no. 6, pp. 1475-7192, 2020.

[8] S. O. Adodo, "Effect of Mind-Mapping as a Self-Regulated Learning Strategy on Students' Achievement in Basic Science and Technology, "*Mediterranean Journal of Social Sciences*, vol. 4, no. 6, pp. 2039-9340, 2013.

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